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National Audit of Clinical Personnel at the Paediatric Emergency Departments in Nigeria

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Abstract: *Background*: The availability of adequate highly skilled clinical staff is essential for good patients' outcome at the Paediatric Emergency Departments (PED). This study aimed to survey the adequacy of clinical staff to deliver emergency care. *Methods*: This was a cross sectional study of 34 tertiary PEDs across Nigeria from 1st June 2017 to 31st January 2019. After ethical clearance, a self-administered questionnaire was used to collect information on the number, certification and shift duty disposition of clinical staff of PEDs. Relationship between the availability of appropriately skilled staff and the regions of the country was conducted using Chi-square, Mann-Whitney U and spearman's rank correlation. *Results*: Over 80% of the PEDs employed less than 6 of all the cadre of doctors while above 70% of PEDs had 2 or less of senior nursing staff. None of the consultants at 18 (52.9%) PEDs were trained in Paediatric Advanced Life Support while majority of the resident doctors (70.4 %) and nurses (85.3%) lacked Basic Life Support certification.About half (52.9%, n=18/34) of the PEDs had two junior nurses per duty shift. There was a statistically significant relationship in the skewed availability of medical fficers (p=0.010) across the zones, however, these was not the case for BLS certification among clinical staff in the country. *Conclusion*: Although the number of clinical staff in the study was sufficient, there was a low rate of advanced life support certification. There are regional variations in the availability of staff strength, cadre and certification in the PEDs in Nigeria. There is a need for urgent intervention to improve these findings.

Key words: Paediatric Emergency Department · Emergency care in Nigeria · Audit of Paediatric emergency personnel · Quality of services in Emergency Department

INTRODUCTION

The role of Paediatric Emergency Medicine (PEM) as a medical sub-speciality aimed at improving the acute care of children cannot be overemphasised [1]. Although, PEM is a well-established sub-speciality in developed countries, however, majority of developing countries still have poorly equipped PEM facilities [1-4].

The provision of emergency services in a dedicated PED is very challenging in Nigeria because of the lack of adequately trained and skilled clinical staff and essential facilities [1]. In Nigeria, the mortality rate among babies that presented to the PEDs is relatively high [5]. This may be related to unavailability and inability to retain skilled paediatric emergency personnel to Mann the PEDs in the low and middle income countries (LMICs) [6].

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Although some reasons for the high mortality and morbidity rate among babies admitted to the PEDs in Nigeria includes out-of-pocket-health expenditure by the parents and guardians of the babies [7, 8], unavailability of essential drugs and appropriate infrastructures [2, 9, 10] however, availability of a high patient-clinical staff ratio is a major determinant of morbidity and mortality [6]. Moreover, having adequate staff in the PEDs will reduce the workload on the staff, guaranty quality services, patient satisfaction and staff wellbeing [1, 11].

Furthermore, the training and certifications of PED staff on advanced life support is very central to the provision of quality emergency care to an acutely ill child presenting at the PED. Indeed, reduction in morbidity and mortality has been documented when PED staff acquire advanced life support skill [12]. Despite its usefulness, studies have shown a poor uptake of these advanced life support courses among PED staff in LMIC [13-15].

We therefore evaluated the numerical strength and advanced life support certification of staff of PEDs in Nigeria and compare across geopolitical zones.

MATERIALS AND METHODS

This was a cross-sectional study of 34 tertiary PED's out of a total 56 tertiary PED facilities in Nigeria from June 2017 to January 2018. For ease of administration, Nigeria is made up of 36 states and a Federal Capital Territory (FCT).These were further subdivided into six (6) geopolitical zones which are; North-West, North-Central North-East, South-West, South-South and South-East Purposive sampling was utilized with the aim of recruiting one PED from each of the 36 states of Nigeria and one PED from the FCT. Twenty states have one PED each and were approached for study recruitment. There was more than one PED in the remaining 16 states and the FCT. A facility was selected from the PEDS in each state that had more than one PEDs using a simple random method.

Data was collected after ethical clearance was obtained from the National ethics committee of the Ministry of Health of Nigeria (NHREC/01/01/2007-21/05/2017) and the University of Witwatersrand (HREC M 1700445). Also permission from hospitals' Chief Executive Officers, Head of Departments (HOD) and Nursing managers was obtained. Hospital and staff identifying information were anonymised.

Relevant sections of the self-administered questionnaire were completed by the HOD and unit nursing manager or their designee and retrieved upon completion. For anonymity, the hospital and staff identifying information were blocked out and replaced with a unique code on the questionnaires. Components of the adapted questionnaire and checklist included: the number of patients triaged into the PED in the last 30 days prior to administration of the questionnaire, the number of patients admitted to the PED short-stay ward, the number of shift duties in the PED, the availability of various grades of doctors and nurses. Also, information about the Advanced Life support certification of the doctors and nurses were collected. This was used to assess the clinical personnel of the PEDs.

Data Management: Adapted from a similar study[16], the included PED's were classified into three categories based on the volume of paediatric visits. The categories were; low (<100 patients), medium (100-500 patients) and high (>500 patients) paediatric volume hospitals.

Data Analysis: Data were entered into an excel spreadsheet (Microsoft® Excel ®) for sorting and were thereafter exported to STATA version 14, (College Station, TX: Stata Corp LP) statistical software. Continuous variables were described using mean and standard deviations while categorical variables were reported using frequencies and percentages.

The independent t-test and analysis of variance (ANOVA) were used to compare the means of normally distributed continuous variables. Post hoc Bonferroni test was performed when ANOVA was statistically significant. The Mann-Whitney U test and the Kruskal-Wallis test were used to compare the median (interquartile range) of non-normally distributed continuous variables. Where appropriate, the Pearson correlation coefficient was used to determine the presence of a linear relationship between various continuous variables. The level of significance was set at $\alpha<0.05$, CI=95%.

RESULTS

In all, 34(91.9%) out of the 37 targeted PEDs responded. Of the 34 PEDs that participated in the study about 52.9% (n= 18/34) were cited in the Northern region of Nigeria while the remainder n=16/34, 47.1%) were cited in the Southern region of the country.

Number of Paediatric Emergency Visits and Admissions in the Last 30 Days Prior to the Study Across the PEDs: The number of paediatric emergency visits to the PED's ranged from 20 - 1500 with a mean (±SD) visit of 253.2 (±261.2). Also, the mean (±SD) number of admissions to the short-stay-ward was 116.4 (±68.3). The PEDs were categorized into low (n=4/34, 11.8%), medium (n=26/34, 76.5%) and high (n=4/34, 11.8%) paediatric volume hospitals. Supplementary Table file.

Supplementary Table 1: Number of paediatric emergency visits and admissions in the last 30 days prior to the study

State (n=34)	Number of patients seen n= 8,610 (%) mean (±SD)= 253.2 (±261.2)	Number of patients admitted n=3,957 (%). mean (±SD) = 116.4 (±68.3)
Low paediatric volume hospital mean(SD) 72.8 (±28.3)		
F	20 (0.23)	30 (0.76)
G	64 (0.74)	64 (1.62)
J	53 (0.62)	41 (1.04)
P	80 (0.93)	40 (1.01)
Medium paediatric volume hospital mean(SD) 50.1 (±32.5)		
A	120 (1.40)	16 (0.40)
B	300 (3.50)	79 (2.00)
C	110 (1.30)	106 (2.70)
D	147 (1.71)	67 (1.70)
E	120 (1.40)	120 (3.03)
I	117 (1.36)	98 (2.48)
K	320 (3.72)	320 (8.10)
M	300 (3.50)	50 (1.26)
N	108 (1.25)	50 (1.26)
O	200 (2.32)	120 (3.03)
Q	100 (1.16)	100 (2.53)
R	200 (2.32)	120 (3.03)
T	259 (3.00)	109 (2.75)
U	150 (1.74)	45 (1.14)
V	200 (2.32)	153 (3.90)
Y	175 (2.03)	123 (3.11)
Z	131 (1.52)	131 (3.31)
A2	430 (5.00)	96 (2.43)
B2	200 (2.32)	120 (3.03)
C2	223 (2.60)	200 (5.05)
D2	120 (1.40)	75 (1.90)
E2	138 (1.60)	101 (2.55)
F2	200 (2.32)	150 (3.80)
G2	426 (4.95)	167 (4.22)
H2	250 (2.90)	130 (3.30)
I2	140 (1.63)	110 (2.80)
High paediatric volume hospital mean (SD)17.8 (±13.1)		
H	500 (5.81)	200 (5.05)
L	659 (7.65)	96 (2.43)
S	1500 (17.42)	250 (6.32)
X	550 (6.39)	280 (7.10)

Clinical Staff Numerical Strength in the Paediatric Emergency Department's: Tables 1 and 2 respectively describe the number of doctors and nurses employed at the 34 PEDs. The median (interquartile range) number of doctors per facility was 5 (1-12) consultants, 4 (0-8) senior resident doctor, 5 (0-12) junior resident doctors, 4 (0-10) medical officers and 8 (2-20) the intern doctors employed at each of the PEDs. Also, the median (interquartile range) number of nurses per facility was 3 (0-6) chief nursing officers, 3 (0-7) assistant chief nursing officers, 6 (0-11) nursing officers and 9 (0-30) nursing officers employed per facility.

Table 1: Number of doctors employed at the 34 Paediatric Emergency Department's

Number of doctors by cadre employed	Paediatric emergency department employing the cadres (n=34)	Percentage (%)
Consultants (n=81)		
0-5	32	92.1
6-10	2	5.9
≥ 11	1	2.9
Senior registrars (n=81)		
0-5	28	82.4
6-10	6	17.7
≥ 11	0	0.0
Junior registrars (n=112)		
0-5	29	85.3
6-10	4	11.8
≥ 11	1	2.9
Medical officers (n=54)		
0-5	32	94.1
6-10	2	5.9
≥ 11	0	0.0
Interns (n=203)		
0-5	19	55.9
6-10	12	35.3
≥ 11	3	8.8

Table 2: Number of nurses employed at the 34 Paediatric Emergency Department's

Number of nurses by cadre employed	Paediatric emergency department employing the cadres (n=34)	Percentage (%)
Chief nursing officer (n=69)		
0-2	26	76.5
3-5	7	20.6
≥6	1	2.9
Assistant chief nursing officer (n=61)		
0-2	25	73.5
3-5	8	23.5
≥6	1	2.9
Nursing officer 1 (n=165)		
0-2	7	20.6
3-5	12	35.3
≥6	15	44.1
Nursing officer 2 (n=217)		
0-2	7	20.6
3-5	10	29.4
≥6	17	50.0

Life support certification amongst clinical staff of the Paediatric Emergency Department's: Amongst doctors, 27 (79.4%), 13 (38.2%), 2 (5.9%) and 2 (5.9%) of the PEDs have 1-5 consultants, senior registrar (SR), junior registrar (JR) and medical officer (MO) respectively with Neonatal resuscitation (NNR) training/certification while 2 (5.9%) have greater than 5 interns with NNR. Also, 23 (67.7%), 5 (14.7%), 1 2.9%) of the PEDs have 1-5 consultants, senior registrars and junior registrars with training in Basic life support (BLS) while 3 (8.8%) PEDs had more than 5 interns with BLS and none of the medical officer have been trained. Furthermore, 14 (41.2%), 3 (8.8%) have 1-5

Table 3: Life support courses amongst doctors at the 34 Paediatric Emergency Department's

Number of doctors by cadre that had completed each life support course	Number of PEDs with the number of doctors having training/certification on advanced life support			
	NNR	BLS	PALS/APLS	ATLS
Consultant				
0	5 (14.7)	9 (26.5)	18 (52.9)	30 (88.2)
1-5	27 (79.4)	23 (67.7)	14 (41.2)	4 (11.8)
>5	2 (5.9)	2 (5.9)	2 (5.9)	0 (0.0)
Senior registrar				
0	18 (52.9)	27 (70.4)	31 (91.2)	33 (97.1)
1-5	13 (38.2)	5 (14.7)	3 (8.8)	1 (2.9)
>5	3 (8.8)	2 (5.9)	0 (0.0)	0 (0.0)
Junior registrar				
0	20 (58.8)	28 (82.4)	32 (94.1)	33 (97.1)
1-5	2 (5.9)	1 (2.9)	0 (0.0)	0 (0.0)
>5	12 (35.3)	5 (14.7)	2 (5.9)	1 (2.9)
Medical officers				
0	32 (94.1)	34 (100.0)	34 (100.0)	34 (100.0)
1-5	2 (5.9)	0 (0.0)	0 (0.0)	0 (0.0)
>5	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Interns				
0	32 (94.1)	31 (91.2)	34 (100.0)	34 (100.0)
1-5	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
>5	2 (5.9)	3 (8.8)	0 (0.0)	0 (0.0)

Table 4: Life support courses amongst nurses at the 34 Paediatric Emergency Departments

Number of nurses by cadre that had completed each life support course	Number of PEDs with the number of doctors having training/certification on advanced life support			
	NNR	BLS	PALS/APLS	ATLS
Chief nursing officer				
0	23 (67.7)	29 (85.3)	34 (100.0)	34 (100.0)
1-2	10 (29.4)	5 (14.7)	0 (0.0)	0 (0.0)
>2	1 (2.9)	0 (0.0)	0 (0.0)	0 (0.0)
Assistant chief nursing officer				
0	24 (70.6)	31 (91.2)	34 (100.0)	34 (100.0)
1-2	8 (23.5)	2 (5.9)	0 (0.0)	0 (0.0)
>2	2 (5.9)	1 (2.9)	0 (0.0)	0 (0.0)
Nursing officer 1				
0	26 (76.5)	31 (91.2)	32 (94.1)	34 (100.0)
1-2	2 (5.9)	2 (5.9)	1 (2.9)	0 (0.0)
>2	6 (17.6)	1 (2.9)	1 (2.9)	0 (0.0)
Nursing officer 2				
0	29 (85.3)	30 (88.2)	33 (97.1)	34 (100.0)
1-2	2 (5.9)	1 (2.9)	0 (0.0)	0 (0.0)
>2	3 (8.8)	3 (8.8)	1 (2.9)	0 (0.0)

consultants and senior registrars with Advanced Paediatric Life Support / Paediatric Advanced Life Support (APLS/PALS) and 2 (5.9%) PEDs have >5 junior registrars with PALS/APLS while none have medical officer and interns with the training. Only 6 (17.6%) of the PEDs have consultants and resident doctors with Advanced Trauma Life Support (ATLS) Table 3.

Amongst nurses, the PEDS with 1-2 Chief Nursing Officer (CNO), Assistant chief nursing officer (ACNO), nursing officer 1 (NO1) and nursing officer 2 (NO2) with NNR training/certification were only 10 (29.4%), 8 (23.5%), 2 (5.9%) and 2 (5.9%) respectively. Also, 5 (14.7%), 2 (5.9%), 2 (5.9%) and 1 (2.9%) PEDS have 1-2 Chief Nursing Officer, Assistant chief nursing officer, nursing officer 1 and nursing officer 2 with BLS. Only 3 (8.8%) facilities had one or more nurses trained in APLS/PALS None of the facilities had any nurse that was trained in ATLS Details of the above findings are described in Table 4.

Number of Clinical Staff per Duty Shift and the Availability of a Senior Registrar During the Night Shift at the Paediatric Emergency Departments: Tables 5 & 6 describe the number of doctors per duty shift and sleep-in senior registrar at the 34 Paediatric Emergency

Table 5: Number of doctors per duty shift and the availability of a senior registrar during night shifts at the 34 Paediatric Emergency Department's

Number of Doctors/ duty shift by cadre	Number of Paediatric Emergency Departments with stated numbers on duty/shift (n=34)	Percent (%)
Consultants		
0	1	2.9
1	32	94.1
2	1	2.9
3	0	0
≥4	0	0
Senior registrar		
0	7	20.6
1	22	64.7
2	5	14.7
3	0	0
≥4	0	0
Junior registrar		
0	7	20.6
1	18	52.9
2	7	20.6
3	1	2.9
≥4	1	2.9
Medical officer		
0	20	58.8
1	11	32.3
2	2	5.9
3	1	2.9
≥4	0	0
Intern		
0	13	38.2
1	15	44.1
2	5	14.7
3	1	2.9
≥4	0	0
Senior registrars sleeps in		
Yes	9	26.5
no	25	73.5

Department's respectively. Most of the PEDs had at least one intern (n=15/34, 44.1%), one junior registrar (n=18/34, 52.9%), one senior registrar (n=22/34, 64.7%) and one consultant (n=32/34, 94.1%) per duty shift. Only 9 (26.5%) PEDs had senior registrars who sleep-in while on call. But all senior registrars can be called from home when required

On the other hand, most of the PEDs had only two nursing officers 2 (n=18, 52.9%), one nursing officer 1 (n=18, 52.9%), one assistant chief nursing officer (n=23, 67.7%) and one chief nursing officer (n=19, 55.9%) per duty shift.

Table 6: Number of nurses per duty shift at the 34 Paediatric Emergency Departments

Number of nurses/ duty shift by cadre	Number of Paediatric Emergency Departments with stated numbers on duty/shift (n=34)	Percent (%)
Chief nursing officer		
0	14	41.2
1	19	55.9
2	1	2.9
3	0	0
≥4	0	0
Assistant Chief nursing officer		
0	10	29.4
1	23	67.7
2	1	2.9
3	0	0
≥4	0	0
Nursing officer 1		
0	4	11.8
1	18	52.9
2	9	26.5
3	2	5.9
≥4	1	2.9
Nursing officer 2		
0	3	8.8
1	9	26.5
2	18	52.9
3	3	8.8
≥4	1	2.9

Comparison of the clinical staff characteristics among the geopolitical zones (ANOVA)

Comparison of the Numerical Staff Strength among the Geopolitical Zones (ANOVA): Table 7 compares the numerical strength of clinical staff among the geopolitical zones. Analysis of variance comparing the numerical strength of clinical staff among the six geopolitical zones revealed a statistically significant relationship among the medical officers (p=0.010) and the Bonferroni test showed a difference in mean number of Medical Officers between North East and North Central (0.018) and North East and South East (0.06).

Comparison of BLS Training/certification of Clinical Staff among the Geopolitical Zones: Table 8 shows the comparison of the BLS certification of the clinical staff across the six geopolitical zones. This table showed no statistically significant differences in the BLS certification among all cadres of clinical staff across the six geopolitical zones.

Table 7: Comparison of the numerical strength of clinical staff among the geopolitical zones (ANOVA)

Number of clinical staff/ Zones	Intern (p=0.234) Mean (SD)	Medical officer (p= 0.010*) Mean (SD)	Junior resident (p=0.690) Mean (SD)	Senior resident (p=0.543) Mean (SD)	Paediatric fellow (p=0.816) Mean (SD)	Nursing officer 2 (p=0.551) Mean (SD)	Nursing officer 1 (p=0.731) Mean (SD)	Assistant Chief nursing officer (p-=0.097) Mean (SD)	Chief nursing officer (p-=0.606) Mean (SD)	Post hoc test
North Central	5.0 (2.4)	0.1 (0.4)	4 (1.4)	3.7 (2.8)	2.3 (1.9)	3.0 (2.6)	5.0 (2.6)	3.0 (2.3)	2.0 (1.5)	*Bonferroni showed difference in MO between NE and NC (0.018) and NE and SE (0.06)
North East	4.8 (3.3)	4.6 (2.3)	2 (3.9)	1.4 (2.6)	3.4 (4.8)	11.8 (5.9)	4.8 (3.9)	2.0 (1.7)	1.4 (0.6)	
North West	3.3 (0.5)	3.0 (4.0)	3.3 (4.7)	2.0 (2.5)	1.3 (0.5)	3.8 (3.2)	4.3 (3.9)	0.7 (0.8)	1.5 (1.5)	
South East	7.6 (7.1)	0.4 (0.9)	3.2 (2.3)	1.8 (1.1)	2.4 (1.9)	5.2 (3.1)	6.8 (3.7)	1.2 (1.1)	2.6 (0.9)	
South South	7.3 (4.7)	1.2 (1.8)	2.5 (1.5)	2.0 (1.3)	2.2 (1.6)	6.0 (1.7)	4.0 (2.3)	1.2 (0.8)	2.2 (2.0)	
South West	8.4 (2.6)	0.6 (0.9)	4.6 (0.9)	3.0 (2.9)	3.0 (2.9)	10.4 (11.4)	4.4 (0.9)	2.6 (1.8)	2.6 (0.9)	

Table 8: Comparison of BLS training/certification of clinical staff among the geopolitical zones (ANOVA)

BLS certification of clinical staff/Zones	Intern (p=0.040) Mean (SD)	Medical officer (p=) Mean (SD)	Junior resident (p=0.800) Mean (SD)	Senior resident (p=0.467) Mean (SD)	Paediatric fellow (p=0.715) Mean (SD)	Nursing officer 2 (p=0.084) Mean (SD)	Nursing officer 1 (p=0.519) Mean (SD)	Assistant Chief nursing officer (p-=0.316) Mean (SD)	Chief nursing officer (p-=0.545) Mean (SD)
North Central	0.0 (7.0)	0.0 (0.0)	1.1 (2.0)	2.0 (3.4)	2.1 (2.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
North East	0.0 (5.0)	0.0 (0.0)	0.0 (0.0)	0.4 (0.9)	2.6 (5.3)	0.8 (1.8)	0.4 (0.9)	0.4 (0.6)	0.6 (0.9)
North West	0.5 (6.0)	0.0 (0.0)	0.8 (2.0)	0.7 (1.6)	0.8 (0.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.3 (0.8)
South East	0.0 (5.0)	0.0 (0.0)	0.6 (1.3)	1.0 (1.7)	2.2 (2.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
South South	0.0 (6.0)	0.0 (0.0)	0.2 (0.4)	0.0 (0.0)	0.8 (0.4)	0.2 (0.4)	0.3 (0.8)	0.0 (0.0)	0.2 (0.4)
South West	4.0 (5.7)	0.0 (0.0)	0.8 (1.8)	0.2 (0.4)	1.2 (0.8)	3.0 (4.5)	1.0 (2.2)	0.6 (1.3)	0.4 (0.9)

DISCUSSION

This study evaluated the numerical strength and advanced life support certification of the staff of PEDs in Nigeria and compared it across geopolitical zones. To the best of our knowledge, this is the first study in Nigeria that conducted a country-wide study to investigate the clinical staff adequacy in the paediatric emergency department (PEDs) in Nigeria.

The study found that the PEDs had the full complement of doctors' cadres available on each duty shift, however, they were deficient in numbers and training in advanced life support and this was not different when compared across the zones of the country.

Number of Clinical Staff Employed in the PEDs: A world health organisation (WHO) report on human resources for healthcare in Nigeria reported that there are 0.3 doctors and 1.03 nurses per 1000of her population [17]. For the optimal management of sick children, an adequate number of clinical staff working as a team with appropriate emergency care competence is necessary. The actual number of physicians required in the PED is dependent on the paediatric patient volume that presents to the ED and the patients level of acuity. There are no agreed ratio but according to the American Academy of Emergency Medicine, approximately 1.5 - 2.5 patients per doctor per hour is regarded as the optimal ratio [18]. The average number of PEDs clinical staff of 15.6(n=531/34) doctors and 15 (512/34) nurses in this study was in keeping with report from a recent regional study in Nigeria [14] and appears marginally sufficient in paediatric low volume hospitals and considering the average of 9 paediatric visits per day with at least 3 doctors per shift [3,9]. However, this number will be grossly insufficient when the medium and high volume hospitals are considered

Life Support Training and Certification Amongst Clinical Staff: From this study, a very small percentage of all the PEDs had staff (doctors and nurses) who had completed the various life support courses (NNR, BLS, APLS/PALS, ATLS). Not surprisingly, the frequency was lower amongst lower cadre of doctors and was even more pronounced amongst nurses. These skills when possessed by clinical staff are vital to delivering quality acute care to children requiring life-saving interventions.

The finding that doctors had low levels of training in advanced life support in our study was similarly reported in other LMICs [13-15]. However, studies from some high income countries also reported limited training in advanced life support amongst the doctors [19, 20] Nonetheless, reports showed that in the United Kingdom (UK) all clinical staff in the PED had received advanced life support training [21].

Amongst nurses, between 8.8% - 14.7% of the PEDs had nursing staff that were trained in BLS. This study finding is better than a report from the study in Yugoslavia [19] where the nurses had no training at all, but is in contrast to the 33.3% reported by a previous regional study in Nigeria [14]. Studies in district hospitals in Botswana [22] and South Africa respectively [23] reported an advanced life support training rate of 48%

and 77.5% among nurses which is higher than our study findings. Furthermore, our study result is very low when compared to the UK where all nurses in the PED had advanced life support training [21].

The reason for the lower rates in relation to other studies may be attributed to the cost of advanced life support training courses, the absence of a pre-employment requirement of certification in these courses and the infantile stage of PEM in Nigeria. An increase in the number of ATLS trained staff in the ED has been associated with a drop in the rates of preventable mortality [12].

Number of Clinical Staff per Shift Duty: All the studied facilities had the full complement of all clinical staff cadres. There were on average three junior doctors (2 interns, a junior resident doctor and or medical officers) per shift covered by at least a senior resident and a consultant. This study finding of two residents and a consultant was slightly better than the Taiwan study that had one resident and a physician per shift [24] while lower than a Saudi Arabian study that had 6 residents with a physician from all sub-specialities available for consultation in the PED [25]. The reason for the differences in the number of doctors could be related to the number of patients presenting, the efficiency of a triaging system and the availability of support resources.

Only 26.5% of the include PEDs had an on-site senior resident during night shift, while the remainder of facilities would call in senior residents when needed. The on-site rate was low compared to 77.8% previously reported in a Nigeria study [14]. The differences in the on-site rate may be because the previous study included only 9 centres from the South of Nigeria, while this study included 34 centres across all regions of the country.

Based on cadre employed, the PEDs had on the average, 5 doctors (all the cadre) during routine day shift. Also PEDs have an average of 9 (253 visits/ 30 day period) paediatric visits and 4 (116 admitted /30 days period) patients admitted per day therefore giving a total of 13 patient load. This gives an overall doctor-patient ratio of 1:2.6. This is very low compared to an Irish study that reported a doctor-patient number per shift of 2:3.5 in the morning and 5:14 in the night [26]. Obviously, the acute shortage of healthcare workers in Nigeria could account for this.

On the other hand, there was an average of 5 nursing staff per shift. This is low compared to the Saudi Arabian study with 12 nurses per PED [25]. This study found a nurse-patient ratio of 1:4, which falls within the 1:3-15 reported by another regional study in Nigeria [14] and similar to the 1:4 reported by studies in California, USA [27] and Australia [28]. The figure was lower when compared to the nursing-patient ratio of 1:2.6 reported by Rossetti et al. in Brazil [29]. The reason for the differences is likely due to shortages of skilled staff in Nigeria and freezing of posts by the government due to poor funding of healthcare in most developing counties. There are recommendations on the ratio of nurses to patients based on certain factors which include patient acuity, admission rates, disposal rates, staff expertise, in-ward space and other resources available in the ED [27]. To maintain and improve on these indices, the ministry should equip the already existing nursing institutes to increase the quantity and quality of nurses in Nigeria.

Comparison of Clinical Staff Characteristics among the Six Geopolitical Zones of Nigeria: Analysis of variance comparing the numerical strength of clinical staff among the six geopolitical zones reveals a statistically significant difference in terms of the number of medical officers ($p=0.010$) and Bonferroni test showed the difference in medical officers to be between NE and NC ($p=0.018$) and NE and SE ($p=0.06$). This is probably due to the widespread residency programme and availability of full staff complement in the tertiary facilities where all the PED are located with little room for medical officers who are not in training. Also it may be that some facilities in the NE zone are not running residency training.

BLS training/certification was used as the basic training on life support for clinical staff in all facilities and this study did not show any significant differences among the geopolitical zones. This could be because there are no regional differences in morbidity pattern of predominantly infectious diseases and less of cardiopulmonary arrest which is more common in infants (especially neonates) due to hypoxia. Hence this may explain the high rate of NNR skills among the clinical staff in PED which is all tertiary level and employs from the same pool of skilled manpower with deficient life support training. A systematic review study strongly support the positive association between residency programme and good patient outcomes[30], same applies to life support training and outcomes[12].

Limitation: This questionnaire-based study was self-administered which may introduce self-reporting bias in the results. Although three targeted centres did not participate, which may introduce selection bias however the studied facilities was equitably distributed per geopolitical zone.

CONCLUSION

Although a full complement of the clinical staff cadre was available in the PEDs, the numerical strength in the included PEDs during the study period,the doctor-patient and nurse-patient ratios during the various shift duty was relatively low. Advanced life support training, which is critical to delivering quality acute care to children requiring life-saving interventions, was deficient amongst clinical staff. These findings were reported in all the regions of the country. Thus, interventions to improve life support certifications and drills should be initiated by the health policy makers in the country.

"What this paper adds"

What is already known on this subject

- Emergency medical care is essential to improve the survival of acutely ill child.
- Most EDs are manned by inadequately skilled personnel in LMIC

What this study adds

- A nation-wide assessment of numbers of PED personnel and their qualifications
- A documentation of the essential certification of personnel working at the PED in Nigeria.
- Documentation of the regional variation in the availability of skilled personnel across the geopolitical zones of Nigeria. - This study draws attention to the state of PEDs in Nigeria and its personnel needs.

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Author Contributions:

CE: Guarantor of the manuscript and responsible for the integrity of the data and the accuracy of the data analysis, data collection, statistical analysis and interpretation of the data; and drafting, writing, review and incorporating co-author feedback, revision and approval of the submission, corresponding author.

AL: Contributed to the study concept and design, statistical analysis and interpretation of the data, the drafting, writing, critical and intellectual and incorporating co-author feedback, revision and final approval of the manuscript,

MM: Contributed to the study concept and design, review and incorporating co-author feedback, revision and final approval of the manuscript

MF: contributed to the study concept and design, review, revision and final approval of the manuscript.

GO: Data analysis and interpretation, critical and intellectual revision of the manuscript.

SO: Contributed to the study concept and design, sample collection, the drafting, writing of the manuscript and revision.

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